COVER SHEET

Kelvin Grove Urban Village: The Use of GIS in Active Transport Planning

Matthew Gray and Dr Jon Bunker

School of Urban Development, Queensland University of Technology

Abstract

Kelvin Grove Urban Village (KGUV) is a $400 million joint initiative of the Queensland Government and the Queensland University of Technology (QUT), delivered in association with the private sector. It is located on 16 ha of land at the former Gona Army Barracks site, next to QUT-Kelvin Grove, and within 2 km of the Brisbane CBD. The development will incorporate around 800 residential units, QUT faculty buildings, shops, restaurants and cafes, all connected by parks and paths intended to promote walking and cycling.

One of the strategic goals of the KGUV Master Plan is to “ensure that people using the urban village can be less car dependant than the general Brisbane population”. This reduction in car dependency requires not only the creation of active transport links within the urban village, but also the existence or creation of such links to the wider city.

A project was conducted between June and October 2005, to:

- Study and qualify regional accessibility to and from KGUV by active transport modes (walking, cycling, and public transport); and
- Identify proposals that will likely improve the regional transport system’s capability to provide for effective accessibility to KGUV by active transport.

A GIS was the primary tool used for the analyses carried out in this study, and allowed the mapping of pedestrian, cycle, bus, train and ferry infrastructure, and the subsequent identification of where improvements may be made to the network. The GIS-based transport analysis software TLOS was used for the first time in Brisbane to integrate both temporal and spatial features of bus and train services into a single analysis.

This paper discusses the use of GIS in transport planning, and the TLOS software in particular, as well as some of the project findings.

1 Introduction

1.1 Increasing Active Transport

Over the last few decades there has been an increasing move towards trying to plan for and provide networks and facilities for active transport—walking, cycling, and public transport—while at the same time as there has been a continuing domination of Western cities by the private motor vehicle. Bicycle riding, for example, was formally excluded from the planning process in previous decades, but is now more seriously addressed because of links to policy and issues of sustainable development, climate change, health, air quality and social exclusion (McClintock 2002). However, in some places cycling remains excluded by experts who choose not to include it as part of urban traffic management and urban design (Yeates 2002). There is a growing effort to increase use of public transport in SE Queensland, after a series of enquiries beginning in the late 1990’s revealed that public transport use in SEQ between 1960 and 1996 fell from 40 percent to less than 7 percent of trips, while motor vehicle use increased dramatically (Cunningham 1999).

There have been changes in many cities away from urban development that has a total dependence on private motor vehicles and a focus on mobility, towards an approach that depends on active transport and a focus on accessibility. Part of this urban planning change has been the development of the urban village, a place wherein the majority of the requirements of a community can be met, and the majority of trips within the village can be made by walking or cycling.

1.2 Kelvin Grove Urban Village

Kelvin Grove Urban Village (KGUV) has been described as a "new high-tech, environmentally sustainable village that will offer a range of residential, educational, health, retail and recreational facilities to residents and visitors…in inner city Brisbane" (DPC 2004). The village is a joint initiative of the Queensland Government and the QUT, delivered in association with the private sector, located on 16 ha of land within 2 km of the Brisbane CBD (Figure 1).

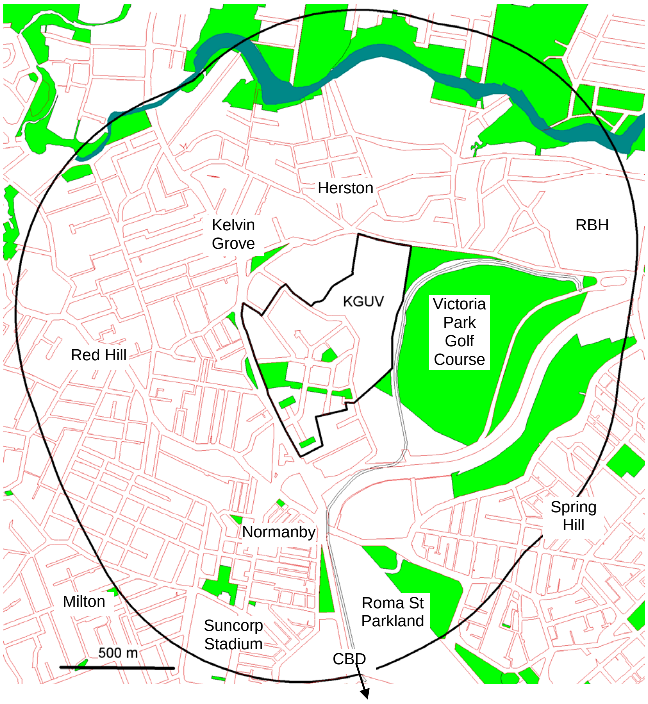

Figure 1: KGUV Frame Area (1 km from perimeter)

The genesis of the KGUV can be seen as part of a growing movement worldwide toward the development of urban villages where, among other things, the role of motorized transport is greatly reduced, and active transport modes of transport are supported and promoted. Newman and Kenworthy (1999:166) list twelve characteristics of successful urban villages; three of these characteristics pertain directly to transport and are:

- A high degree of self-sufficiency to meet local needs but with good rail and bus links to the wider city.
- A rail station near the core.
- Pedestrian and cycle links.

It is not enough to simply restrict car use; other viable transport alternatives must be made available (Newman and Kenworthy 1999). KGUV does not have a rail link near the core, although there is a busway station on the eastern side and a major bus corridor along the western side of the site. There has been deliberate planning to create a high degree of self-sufficiency, and to create a network of pedestrian and bicycle paths within the urban village. The question that needed to be answered was: are there good active transport links with the wider city?

2 Goal and Purpose of Project

One of the strategic goals of the *KGUV Integrated Master Plan, August 2004* is to “ensure that people using the urban village can be less car dependant than the general Brisbane population”. This reduction in car dependency requires not only the creation of active transport links within the urban village, but also the existence or creation of active transport links to the wider city within the KGUV Frame Area. The purpose of *this* project was to:

- study and qualify regional accessibility to and from KGUV by active transport modes (walking, cycling, and public transport); and
- To identify proposals that will likely improve the regional transport system’s capability to provide for effective accessibility to KGUV by active transport.

3 Infrastructure and service components examined

The types of active transport infrastructure and services examined in this study were facilities for walking, cycling, and public transport. Table 1 summarises considerations for walking and cycling.

Table 1: Summary of considerations for active transport

Mode	Infrastructure	Considerations
Walking	Footpaths and pathways	Quality and accessibility Pathway surface, width, gradient, route, directness, lighting, signage Connection to meaningful destinations Connection to other transport modes Safety and security
Cycling	Shared and dedicated bicycle pathways	Pathway surface, width, gradient, route, directness, lighting, curves, sight lines and distances Connections to meaningful destinations Facilities for securing bicycles at destinations Connection to other transport modes Facilities for securing bicycles at transport interchange Ability to travel with bicycles on public transport
	Bicycle routes on roads	Unmarked routes on shared roadways Marked shared zones Marked bus/bike lanes Marked segregated lanes Protected lanes on roadway (i.e. median separating motor vehicles from bicycles)
	End-of-trip facilities	Lockers and showers at businesses and residential premises Secure bike storage areas at stations, stops, and ends of trips, including racks, enclosed racks and bike lockers

The Quality of Service framework for transit consists broadly of availability, and comfort and convenience; this study considered only the service measures for availability, shown in Table 2.

Table 2: Transit quality of service framework (From (TRB 2004))

	Service Measures		
	Transit Stop	**Route Segment**	**System**
Availability	Frequency	Hours of service	Service coverage
Comfort and convenience	Passenger load	Reliability	Transit-Auto Travel Time

The considerations for public transport service availability are shown in Table 3, and include both temporal (service) and spatial (infrastructure) considerations.

Table 3: Summary of considerations for transit

Mode	Infrastructure	Considerations
Bus	Stationary facilities	Bus stops and stations need to be appropriately located, configured and be accessible to people with reduced mobility Facilities must be provided at bus stations for cyclists to secure bicycles Security and lighting Protection from adverse weather (e.g. sun, rain)
	Mobile facilities	Buses need to be accessible, reliable, and comfortable Services must be scheduled to be: Frequent Regular Adequate capacity must be provided
	Bus routes	Must be: Appropriate (i.e. stopping close to destinations) Expeditious (i.e. direct rather than circuitous) Not duplicated. Bus routes must connect with other services, as well as with rail, walking and cycling modes. Services need to be timetabled to integrate with activities at QUT-KG, KGUV, at other venues in the CBD and wider city, other bus services, train services, and walking and cycling trip legs. Ample signage of routes, services, and destinations needs to be provided. Residents, students and employees must be educated as to available routes and services
Rail	Connectivity	Pathways for walking and cycling Connection to bus routes between KGUV and nearby train stations.
	Services	Services must be frequent, reliable and regular. Timetabling of bus and train services needs to be integrated
Ferry	Connectivity	Bus and ferry service timetables need to be integrated to allow connectivity.

4 GIS in Transport Planning

The use of GIS in land use planning has become ubiquitous, and although its use in transport planning appears to be not so widespread, it is still very significant. Its increasing uptake has been because it can “benefit either directly or indirectly all facets of urban transport planning” (Ferreira and Jensen 1992). In transport planning GIS provides benefits for

- data collection and storage
- model building and validation

- prediction of impacts and strategy evaluation
- public consultation and participation
- continuous transport system monitoring

A 1992 survey of 67 transit and transport planning bodies in the US found that 36 were already using GIS, and most were contemplating their use (Schweiger 1992). A similar, more recent review has also been conducted (TRB 2005). The uses these bodies were putting their GIS to included:

- Planning, such as ridership forecasting, service planning and modification, transit and land use development analysis and market analysis
- Marketing, such as demographic analysis and customer info
- Facilities inventory and management
- Real estate inventory and management
- Maintenance of rights-of-way, vehicles and stations
- Engineering

4.1 Previous studies

Previous studies that have used GIS integrated with transport planning appear to have been undertaken mainly by transport and municipal authorities as part of their ongoing business. The approach taken in this study is a combination of several of the methodologies used in previous studies. In particular, the TLOS software developed by Kitterson and Associates Inc. (KAI) and URS Inc. (KAI and URS Inc. 2001; 2005b) will be used as a tool for modelling the levels of service provided to KGUV by bus and train services, integrating frequency, hours of service and service coverage (identified in Table 2).

4.2 Approach

The approach used for this study was to source data from a number of institutions including Brisbane City Council (BCC), Qld Transport (including TravelSmart and Translink), Australian Bureau of Statistics 2001 Census, QUT and KGUV. Data was also be collected from direct observations in the field, and from information already in the public domain, such as timetables for Queensland Rail train services, BCC ferries and Brisbane Transport buses. These data were incorporated into the GIS and blended to produce maps tracking the likely routes for walking and cycling between KGUV and via the Frame Area, the CBD, and other attractors, such as hospitals, schools, community and sporting facilities. Timetable data was merged to produce tables of connectivity between services, such as trains from the Caboolture, Ipswich, Shorncliffe, Cleveland and Beenleigh rail lines, and Brisbane ferry and Citycat services, transferring passengers to buses servicing KGUV. The GIS mapping used for tracking walking and cycling infrastructure was extended to produce a data set for analysis using the TLOS software. This software allows for the visual illustration of various indicators of levels of service, as well as the production of TLOS indicators. This is especially relevant for assessing the impact of changes or additions to services and facilities that are currently planned but for which data on impact do not currently exist. This process is illustrated in Figure 2.

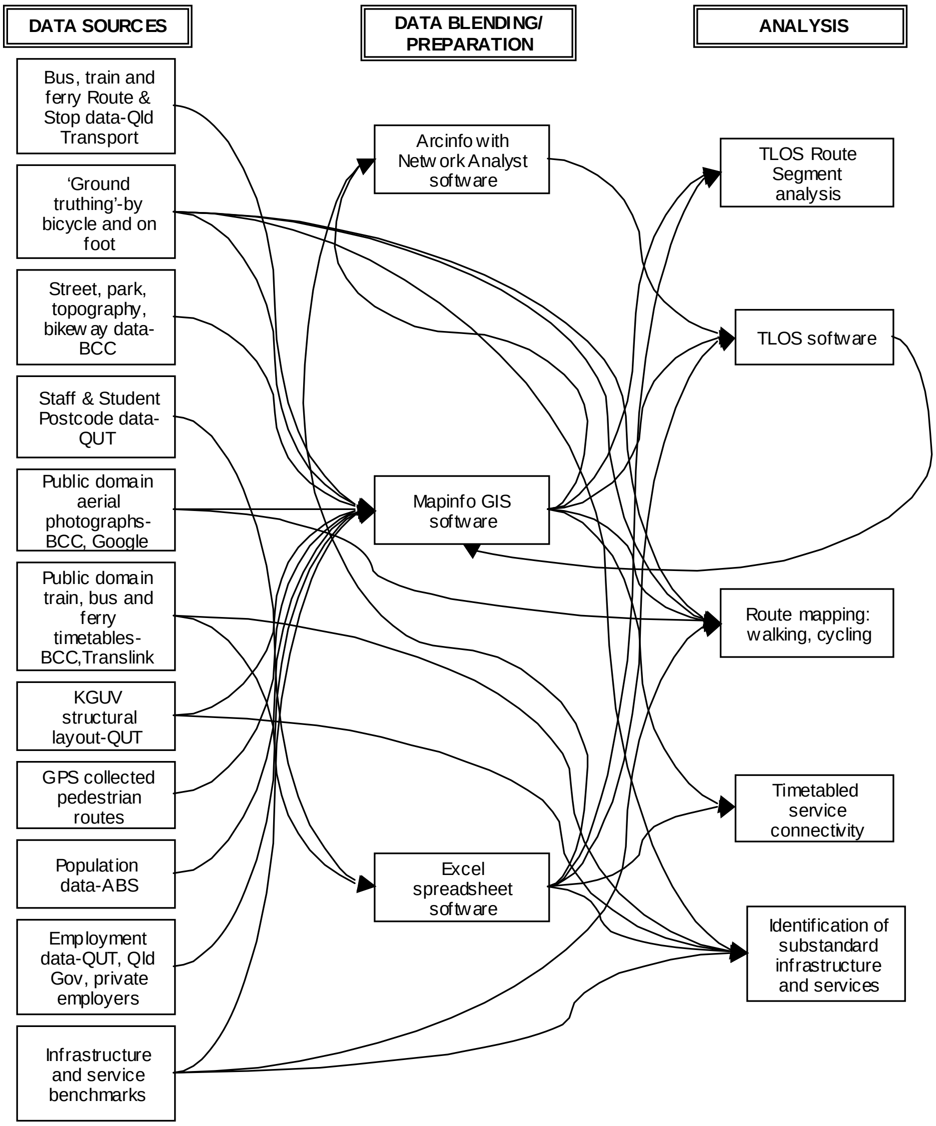

Figure 2: Data source, handling and analysis schematic

5 Analyses

5.1 Transit Level of Service

The primary tool used in this analysis is the TLOS software developed by Kittelson and Associates, Inc. and URS Inc., and distributed free-of-charge by the Florida Department of Transport. This software utilises GIS technology to analyse transit service at a number of levels, but because of the constraints of this project only a small amount of the capacity of this software was utilised. Substantial scope exists to expand the range and detail of analysis possible if this software was to be used in a future project. For the current project, two primary tools were used; Route Segment Analysis and TLOS Indicator.

5.1.1 Route segment analysis

The route segment analysis tool provided as part of TLOS allows for the analysis of level of service along a single route by all bus services that serve that route. Route segment analysis is a limited but much quicker method for analysing the coverage along one particular road. Percentage figures are calculated on how many minutes during the analysis period that the stop is served by transit. A stop is considered to be served by transit both during the minute (or longer) that a vehicle is actually at the stop, as well as for an assumed passenger wait time. In this case the assumed wait time is five minutes prior to the scheduled arrival time. The analysis shown in Figure 3 is for Kelvin Grove Road These analyses look at the three routes in isolation, but can examine all services that stop at the stops examined. It does not provide the more thorough analysis that the full TLOS software does, but it is much faster to initialise and run. This analysis assumed a 400 metre (1/4 mile; 5-minutes' walk) buffer and a 5-minute wait time at each bus stop. The TLOS percentages indicate the number of minutes each hour that people can catch a bus at that stop. For example, a score of 100% means that a bus arrives every 5 minutes (i.e. no one has to wait longer than 5 minutes for a bus), while a score of 50% indicates a bus every 10 minutes. If the assumed wait time is 10 minutes, however, a bus every 10 minutes will provide a 100% TLOS indicator. The TLOS indicator is comparable to the TCQSM LOS based on bus headway (KAI and URS Inc. 2005a; TRB 2004), but the assumed wait time used for the TLOS calculation must be stipulated.

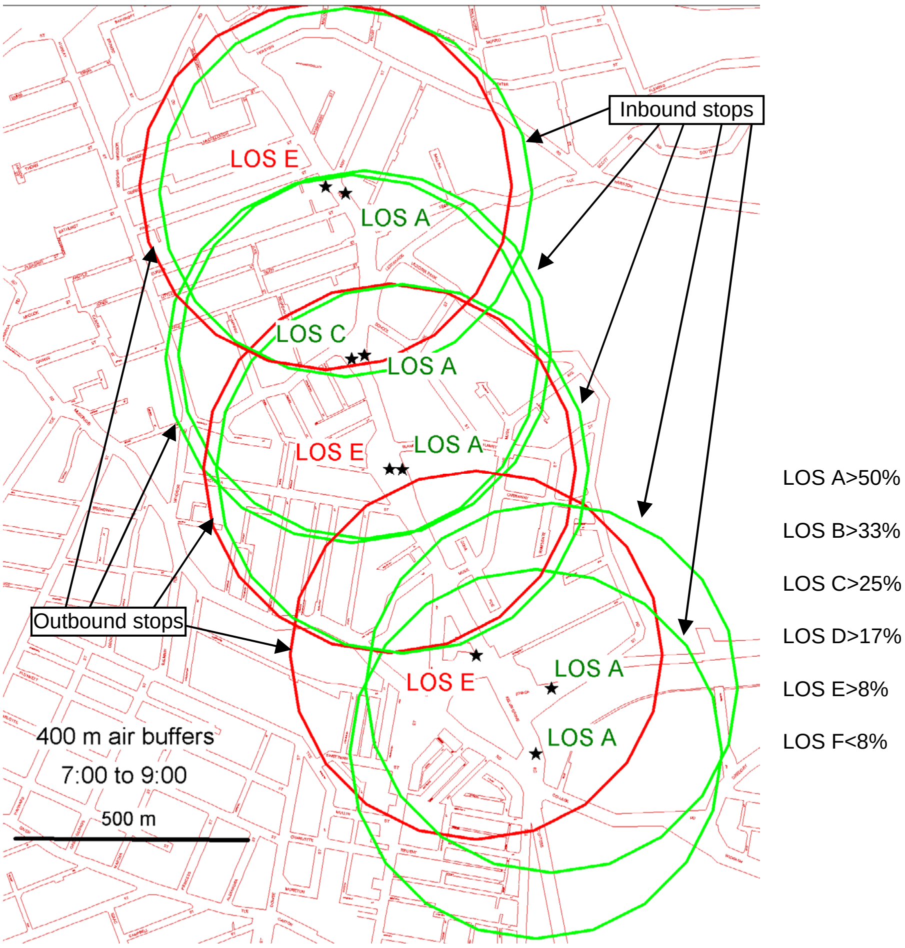

Figure 3: TLOS route segment analysis for Kelvin Grove Road, 7-9 AM

5.1.2 TLOS

TLOS is a software package that calculates the level of service for a study area considering frequency, service span, coverage, and pedestrian accessibility to stops. TLOS calculations were carried out for the area immediately around KGUV. A more thorough investigation of connectivity of KGUV with the wider city would require incorporation of far more stops and services, particularly in the

CBD. By entering population and employment data, the relative coverage of population and employment in a study area may also be calculated. For this study a series of colour illustrations of the TLOS values for KGUV were generated; unfortunately these colour pictures do not reproduce well here. Some significant findings include the dependence on the QUT-shuttle, and lack of transit service to the southern end of KGUV.

6 Conclusions

The use of GIS in this project proved to be a powerful and accessible tool for transport planning. A number of both qualitative and quantitative analyses were performed. The GIS used in this project allowed for:

- the identification of best pedestrian routes to the CBD;
- identification of unsafe bicycles routes, and best locations of new routes;
- illustration of service coverage of transit services;
- identification of areas where more frequent services are required; and
- identification of times (daily, weekly, yearly) when more services are required

Bibliography

Cunningham, N. (1999) *Inquiry into SEQ Public Transport* (Updated 12 Nov 1999, Accessed 10 Jun 2005) http://parliament.qld.gov.au/view/committees/documents/TSAFE/media/TMR991112.pdf

DPC (2004) *Kelvin Grove Urban Village* (Updated April 2004, Accessed 18 May 2005)

Ferreira, L. and Jensen, C.D. (1992) *Geographical information systems and transport planning : a marriage of convenience.* Physical Infrastructure Centre, Queensland University of Technology, Brisbane.

KAI and URS Inc. (2001) *Transit Level of Service (TLOS) Software User's Guide. Version 3.1,* Florida Department of Transportation Public Transit Office, Kittelson & Associates Inc., and URS Inc. http://www.dot.state.fl.us/transit/Pages/transitlevelofservicesoftware.htm

KAI and URS Inc. (2005a) *Transit Level of Service (TLOS) Concepts Guide. Version 4.0,* Florida Department of Transportation Public Transit Office, Kittelson & Associates Inc., and URS Inc.

KAI and URS Inc. (2005b) *Transit Level of Service (TLOS) Software User's Guide. Version 4.0,* Florida Department of Transportation Public Transit Office, Kittelson & Associates Inc., and URS Inc.

McClintock, H. (2002) Chapter 1: The mainstreaming of cycling policy. In *Planning For Cycling: Principles, Practice and Solutions For Urban Planners* (Ed, McClintock, H.) Woodhead Publishing, Cambridge, England, pp. 1-16.

Newman, P. and Kenworthy, J. (1999) *Sustainability and Cities: Overcoming Automobile Dependance,* Island Press, Washington, DC.

Schweiger, C.L. (1992) Current use of geographic information systems in transit planning. *Transportation Research Record,* **1349** 93-106.

TRB (2004) *Transit Capacity and Quality of Service Manual. 2nd edition,* Transportation Research Board, National Academy of Sciences, Washington, DC. http://trb.org/news/blurb_detail.asp?id=2326

TRB (2005) *Geographic Information Systems Applications in Transit.* Transportation Research Board, Washington, DC.

Yeates, M. (2002) Chapter 4: Making space for cyclists: A matter of speed? In *Planning For Cycling: Principles, Practice and Solutions For Urban Planners* (Ed, McClintock, H.) Woodhead Publishing, Cambridge, England, pp. 50-71.

Cite as;

Gray, Matthew and Bunker, Jonathan M (2005) Kelvin Grove Urban Village: The use of GIS in active transport planning. In Dia, Hussein and Bunker, Jonathan M, Eds. *Proceedings of the 27th Conference of Australian Institutes of Transport Research*, Brisbane.